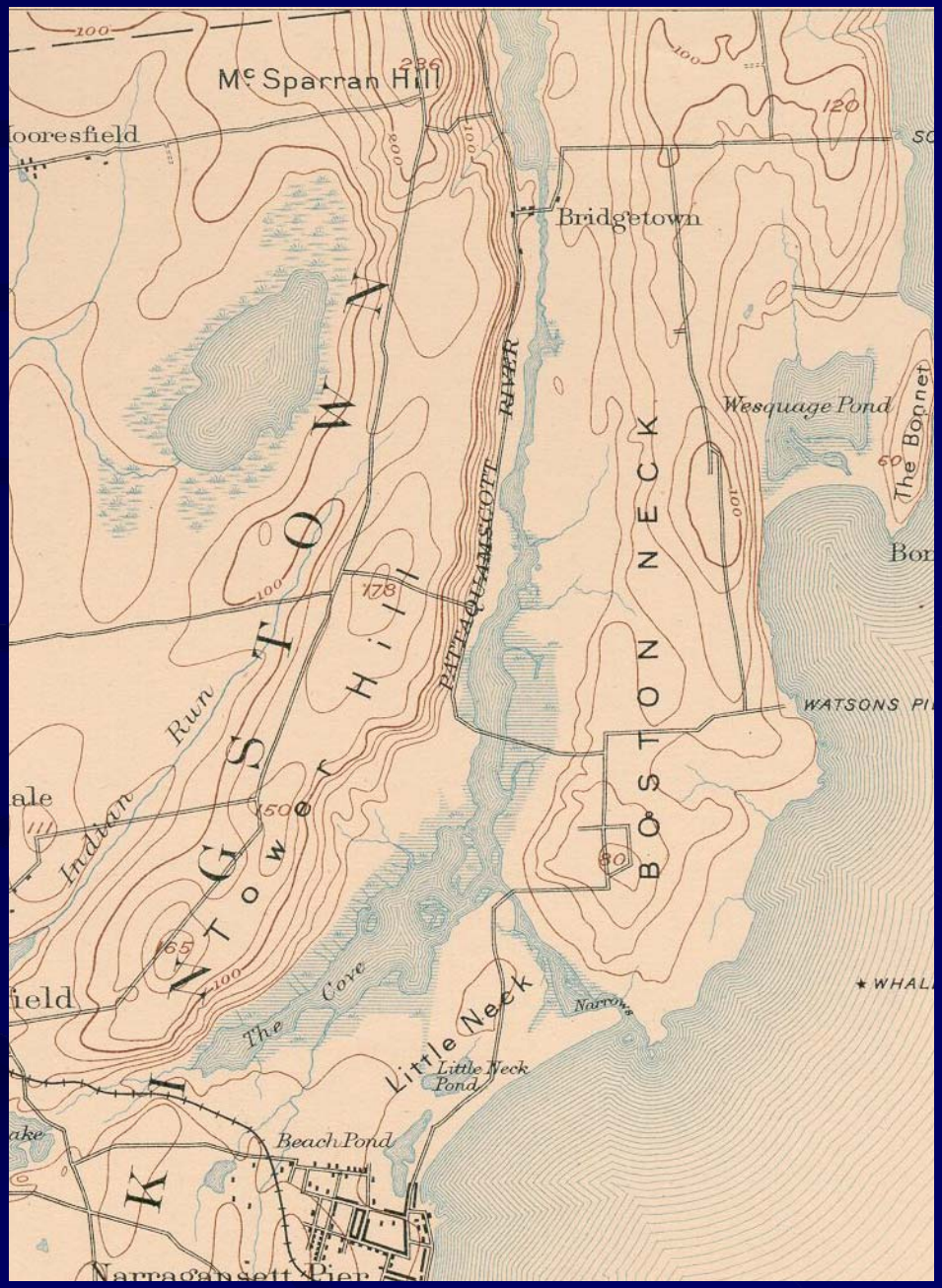
Narrow River Ecosystem Restoration Project Update September 2008

New England District
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Problems

- Degraded water quality contributing to aquatic habitat degradation
- Loss of salt marsh
- Loss of eelgrass habitat
- Loss of shellfish habitats

1894 Topographic Map

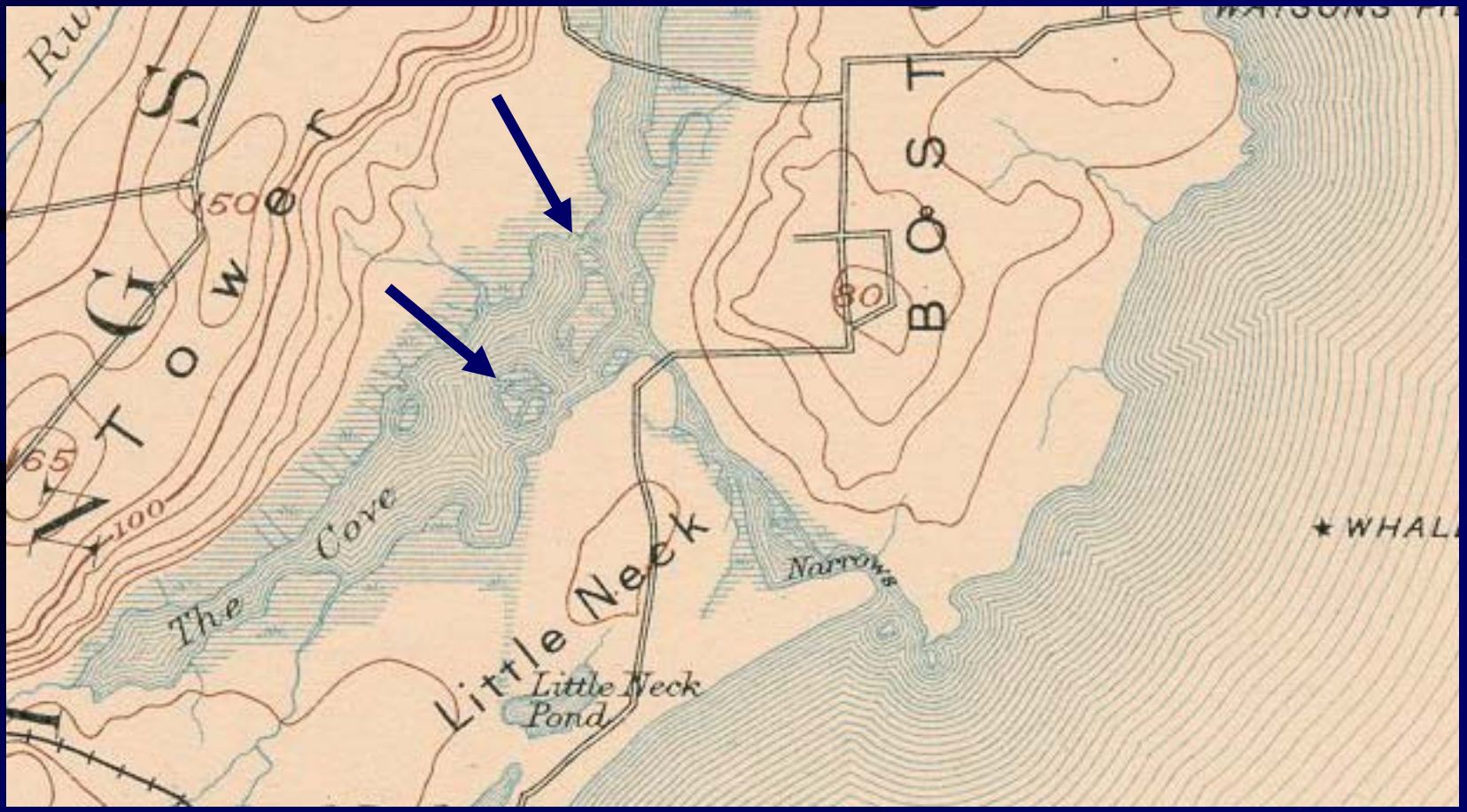


Narrow River in 1939

Lost Salt Marsh

(Isolate Nutrient Enriched Sediments)

1894 USGS Map



Degraded Salt Marsh

1997

1939

Eroding Salt Marsh

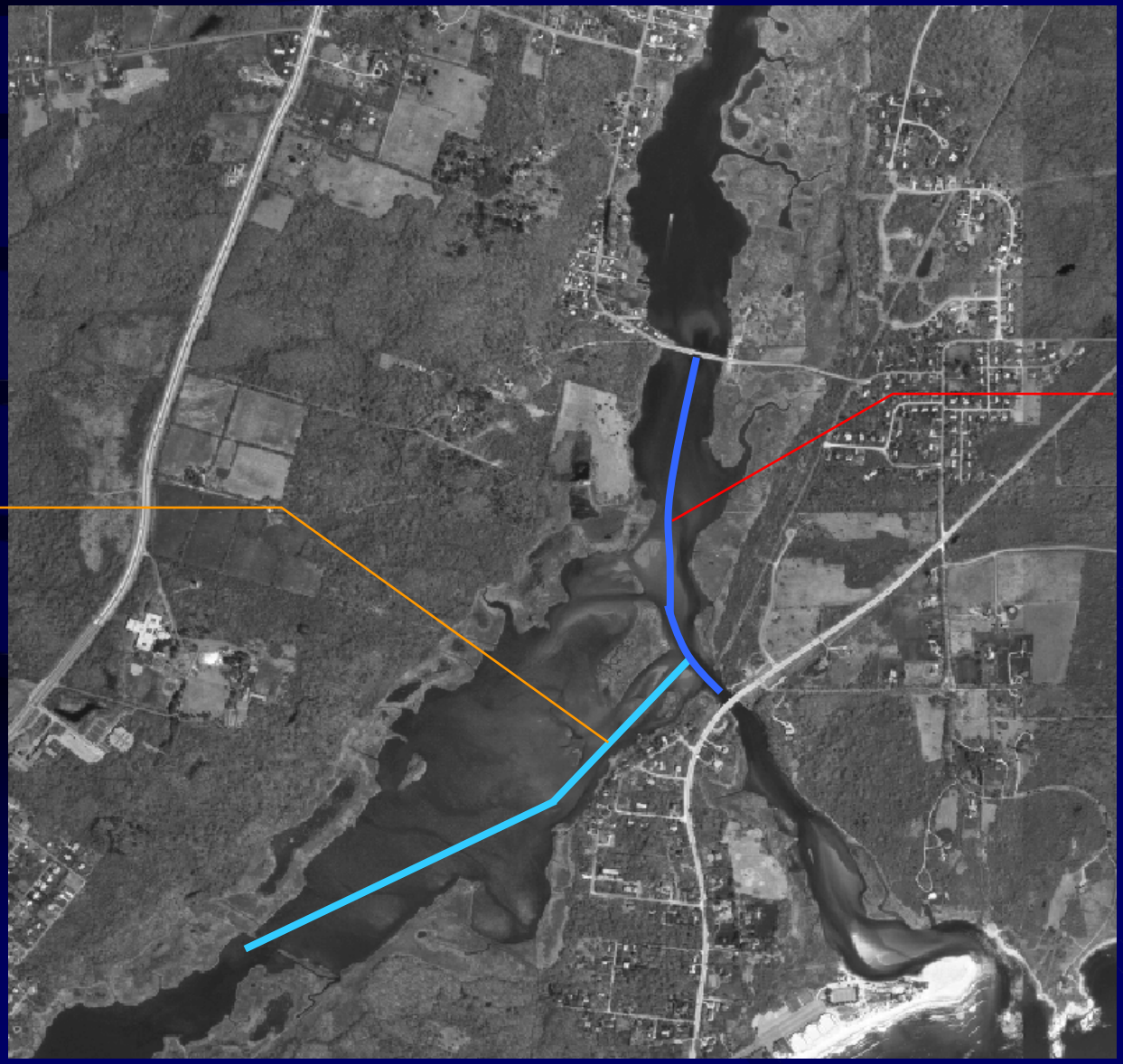
(Reduce sediment suspension)

Eroding Marsh

Boat Prop/Wake Erosion

(Reduce salt marsh erosion and sediment suspension)

Potential Channels



~4’ deep channel to improve flushing

3’ deep by 25’ wide navigation channel to control erosion/eelgrass disturbance

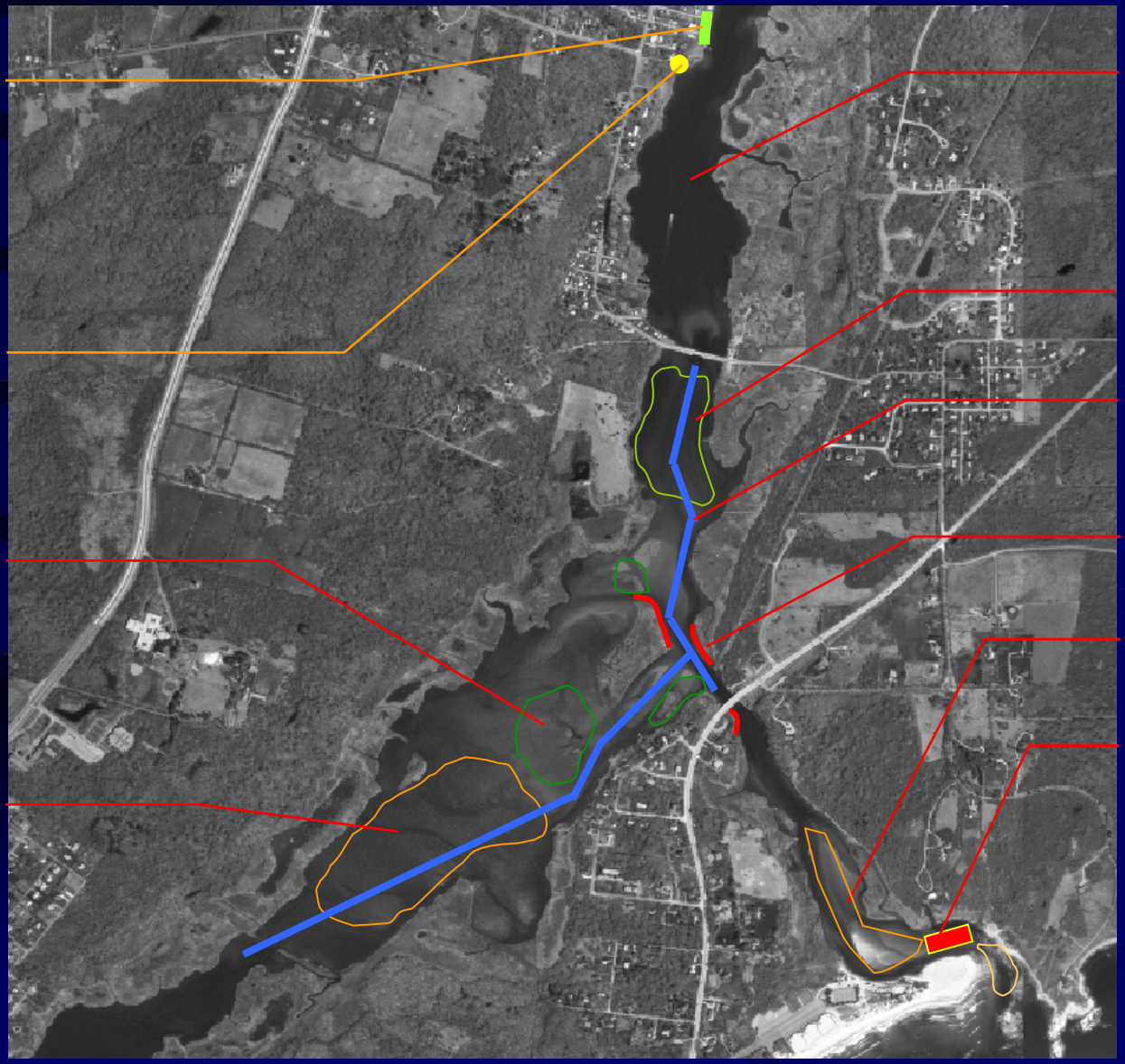
Degraded Aquatic Habitats Eelgrass and Shellfish

(Increase nutrient removal/filtration)

Eelgrass N of Middle Bridge

Potential Restoration Measures

Potential Project Features



Plant Buffer Zones

Sediment/ Nutrient BMPs

Restore Salt Marsh Substrate & Plant

Restore Substrate for Shellfish/Eelgrass

Restore Eelgrass by improving Water Quality

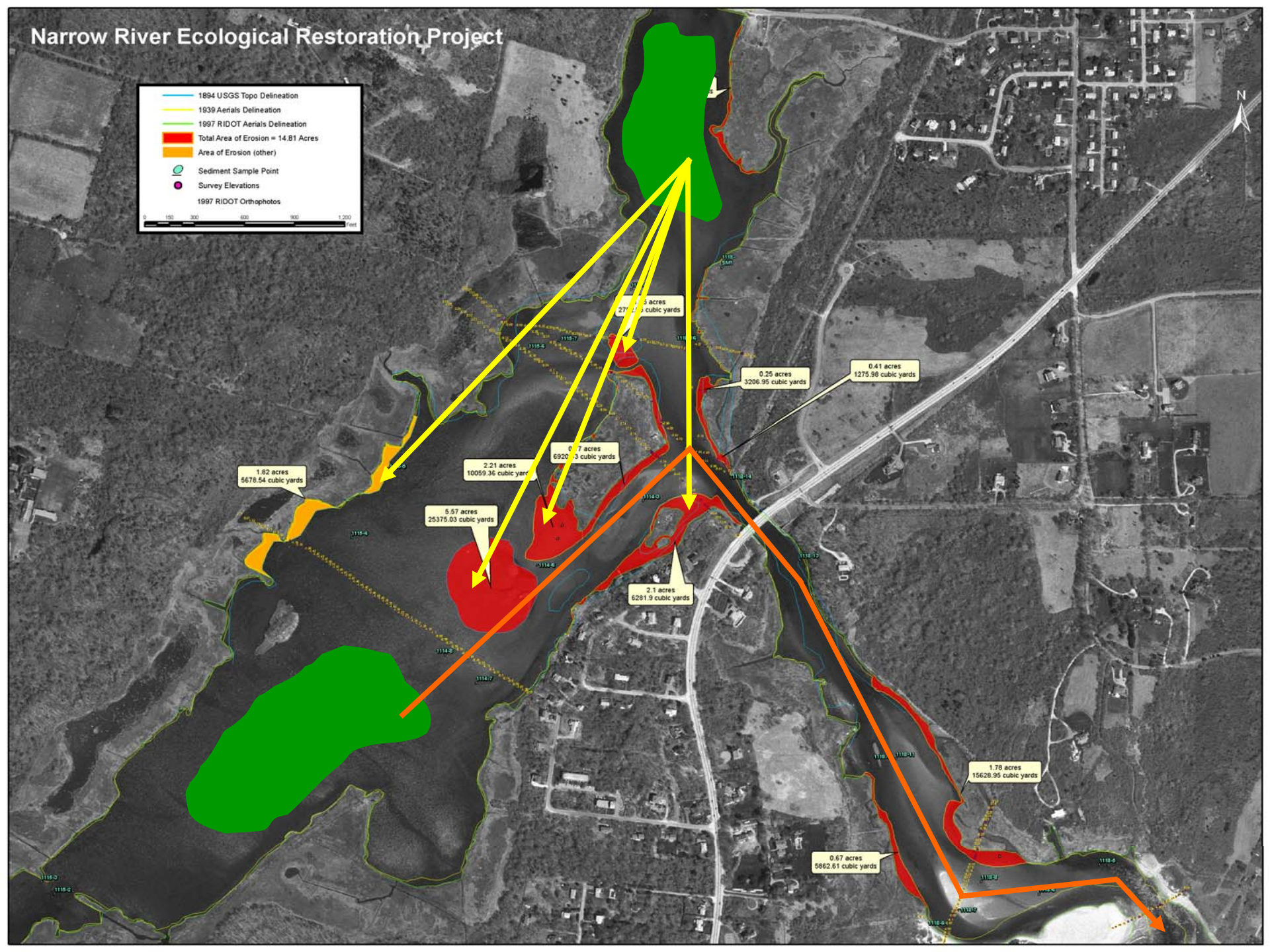
Restore Eelgrass

Establish Navigation Channel

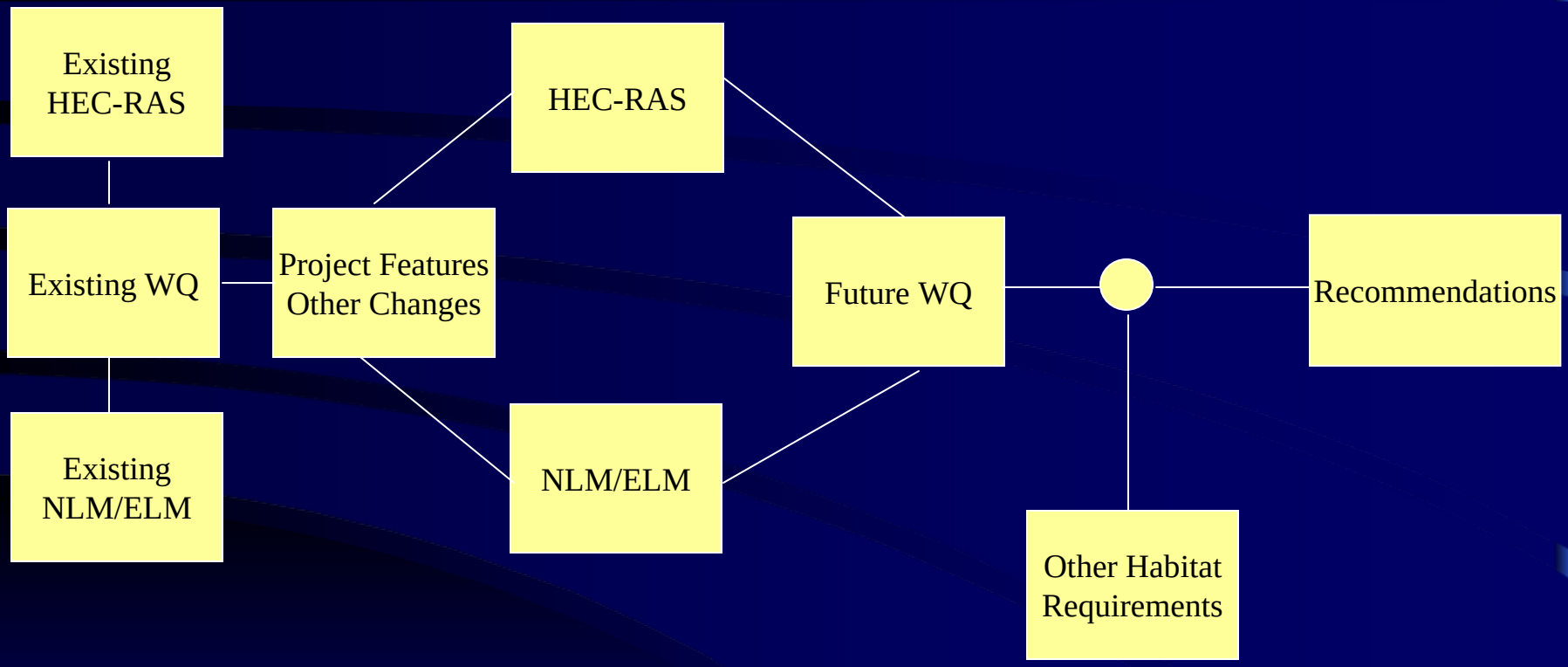
Protect Salt Marsh Edges

Dredge for Flushing

Construct Sedimentation Basin

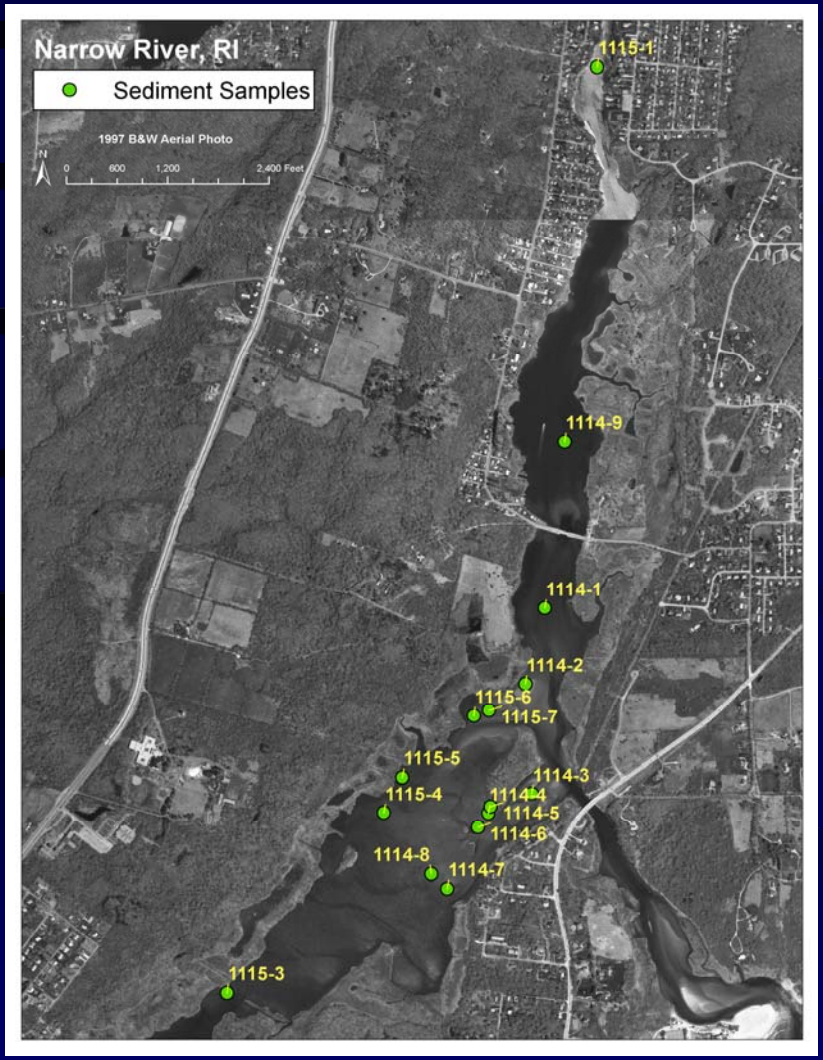

Narrow River Ecological Restoration Project
1894 USGS Topo Delineation
1939 Aerials Delineation
1997 RIDOT Aerials Delineation
Total Area of Erosion = 14.81 Acres
Area of Erosion (other)
Sediment Sample Point
Survey Elevations
1997 RIDOT Orthophotos
0 150 300 600 900 1,200
Feet
N
0.25 acres
3206.95 cubic yards
0.41 acres
1275.98 cubic yards
1.82 acres
5678.54 cubic yards
2.21 acres
10059.36 cubic yards
5.57 acres
25375.03 cubic yards
2.1 acres
6281.9 cubic yards
1.78 acres
15628.95 cubic yards
0.67 acres
5862.61 cubic yards

Information Flow



Sediment Management

Sediment Sample Locations



- ~25 sampling stations
- Sediment grain size
- Sediment nutrient concentration
- Sampled 2005/2008

URI Sediment Mapping

See PDF

Sediment Grain Size

- Narragansett Beach
  - >99% sand; 0.2 to 0.4 mm median size
- Flood tidal shoal
  - >96% sand; 0.2 to 0.4 mm median size
- Lower River
  - 59 to 92% sand; 0.1 to 0.2 mm med size; hi OM
- Pettaquamscutt Cove
  - 8 to 91% sand ; high organic matter

Improve Water Quality

Water Quality Improvement

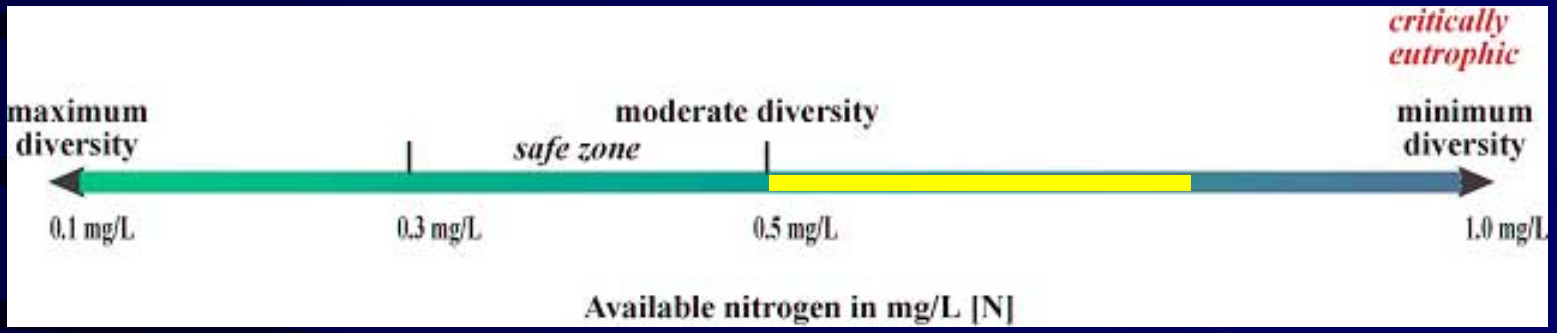
- Reduce nutrient input from the watershed
- Reduce nutrient transfer from the sediments to the water
- Increase nutrient uptake by vegetation and shellfish
- Increase flushing of nutrients from the estuary

Corps Water Quality Policy

- May involve measures to improve water quality parameters as components of ecosystem structure and function
- May not include activities that would principally treat or otherwise abate pollution problems caused by other parties who have…a legal responsibility for remediation or compliance

Nitrogen Concentrations

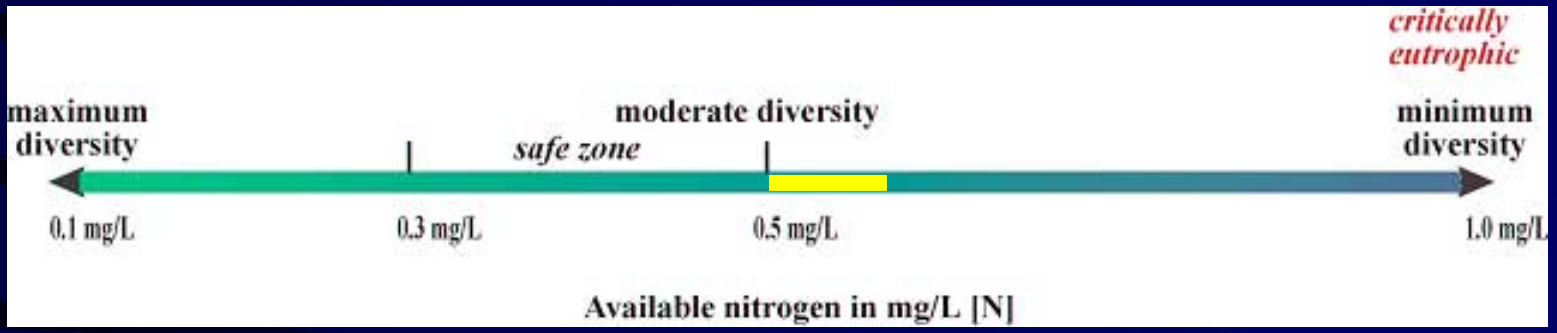
Benthic Resources Diversity



- Concentrations in the Narrow River:
  - Upper Pond and Lower Pond 0.5-0.8 mg/L
  - Lacey Bridge to Middle Bridge 0.5-0.6 mg/L
  - Middle Bridge to Sprague Bridge 0.3-0.6 mg/L

Nitrogen Concentrations

Benthic Resources Diversity



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Nitrogen Concentrations

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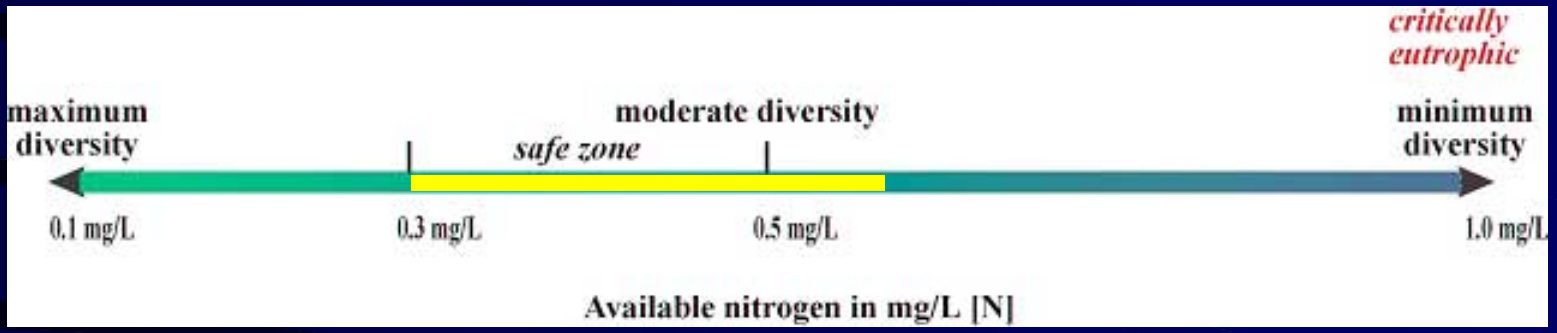

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  - Upper Pond and Lower Pond 0.5-0.8 mg/L
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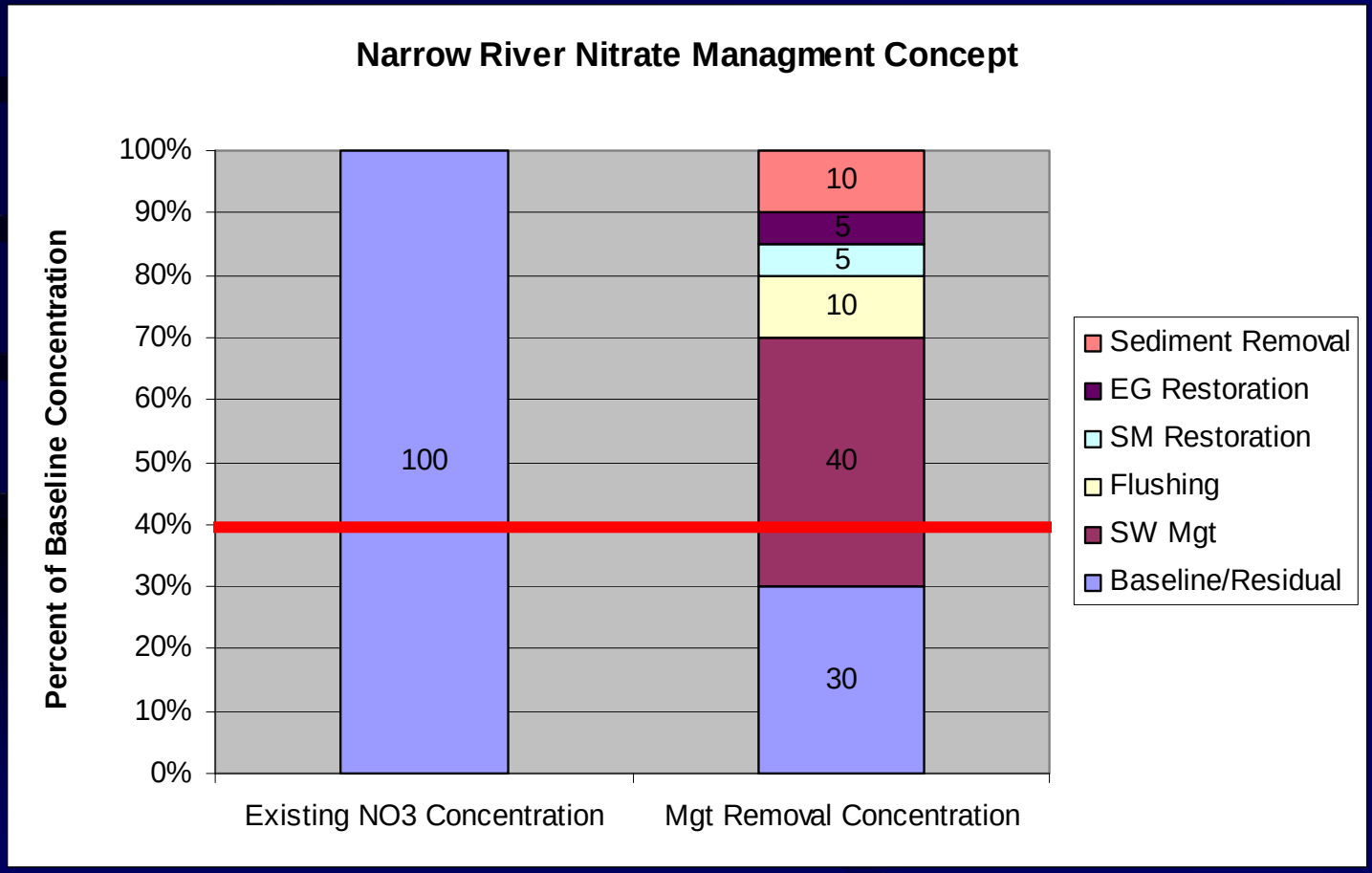
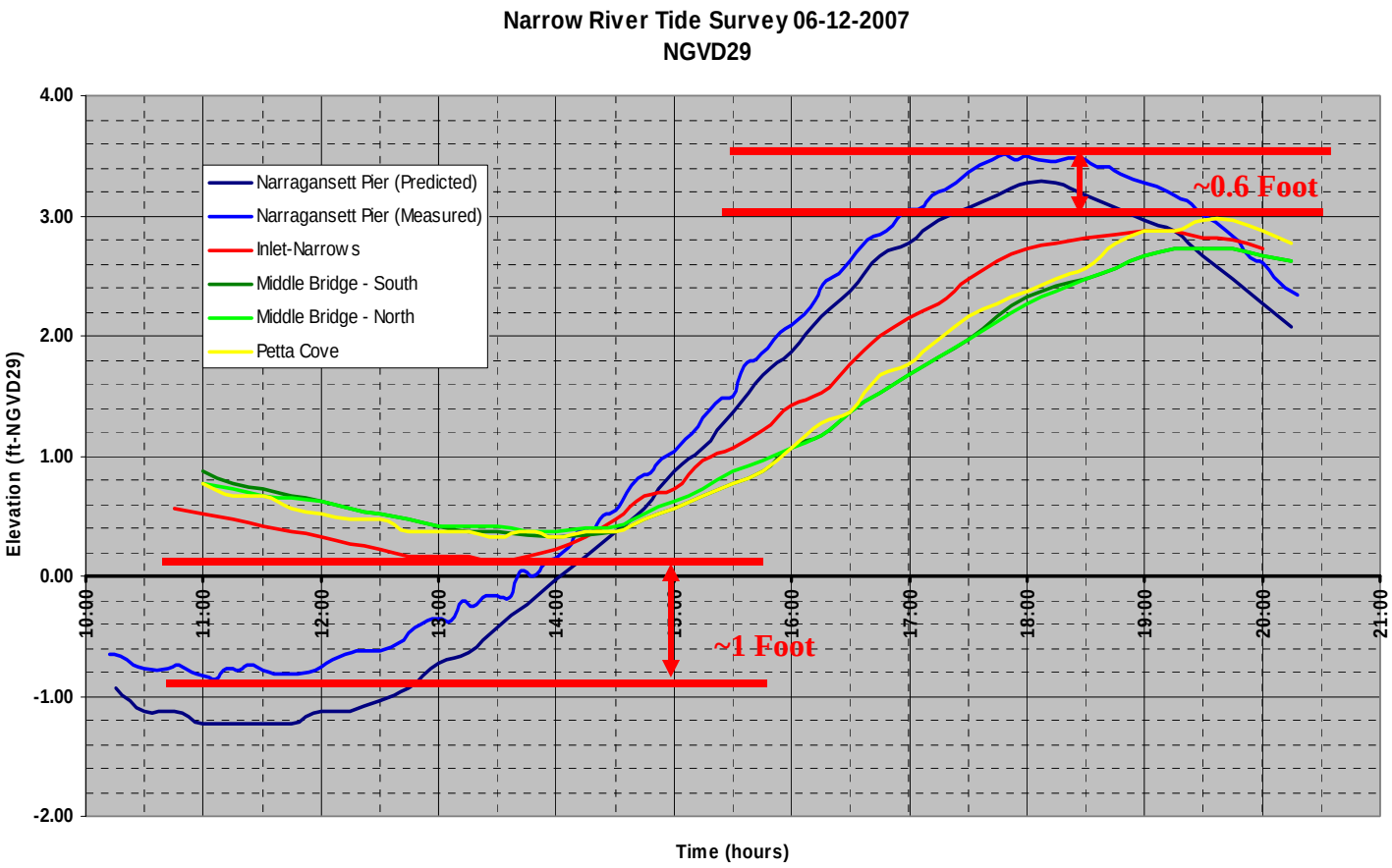
Nitrate Reduction Concept



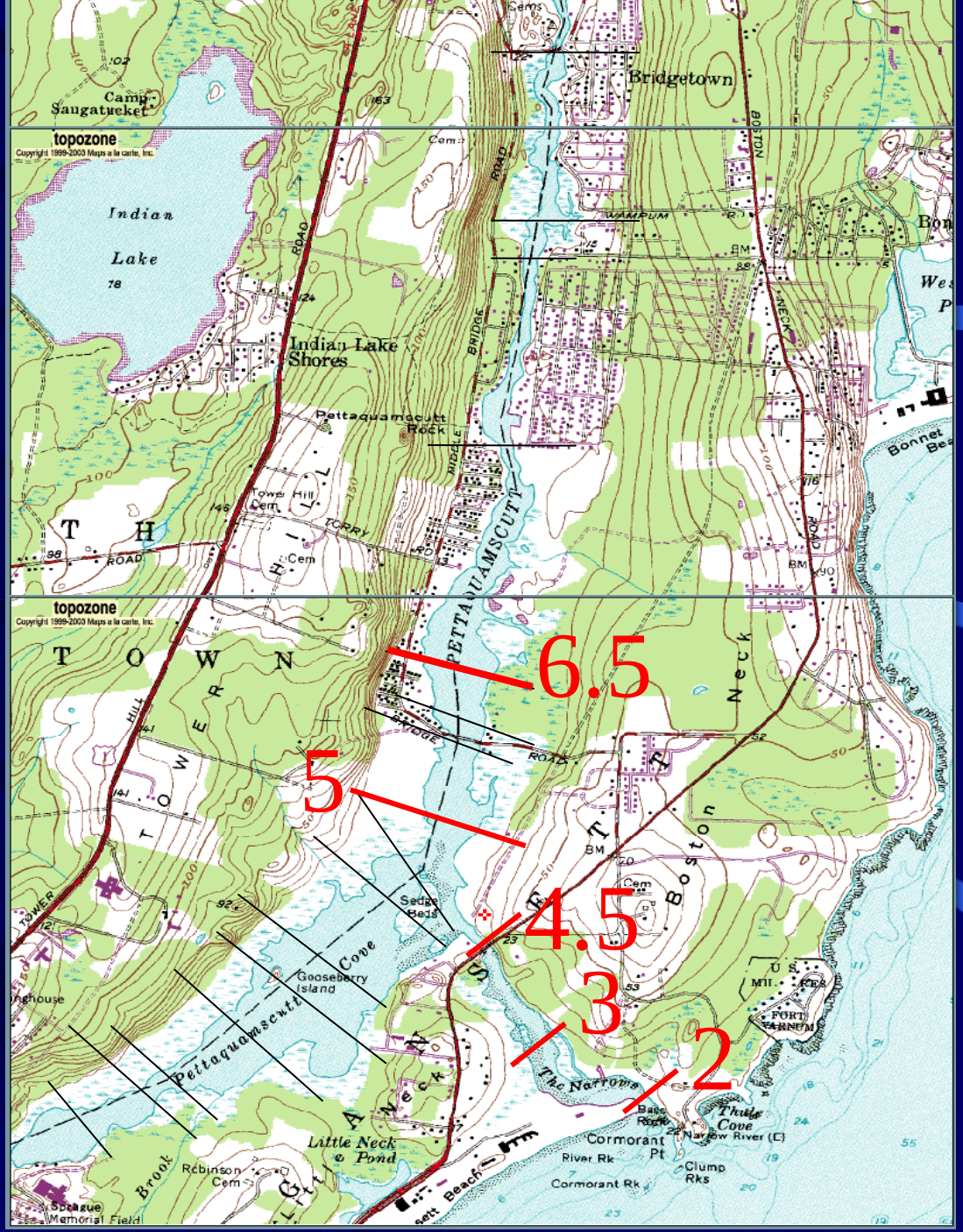
Restore/Improve Tidal Flushing

(Reduce nutrient concentrations)

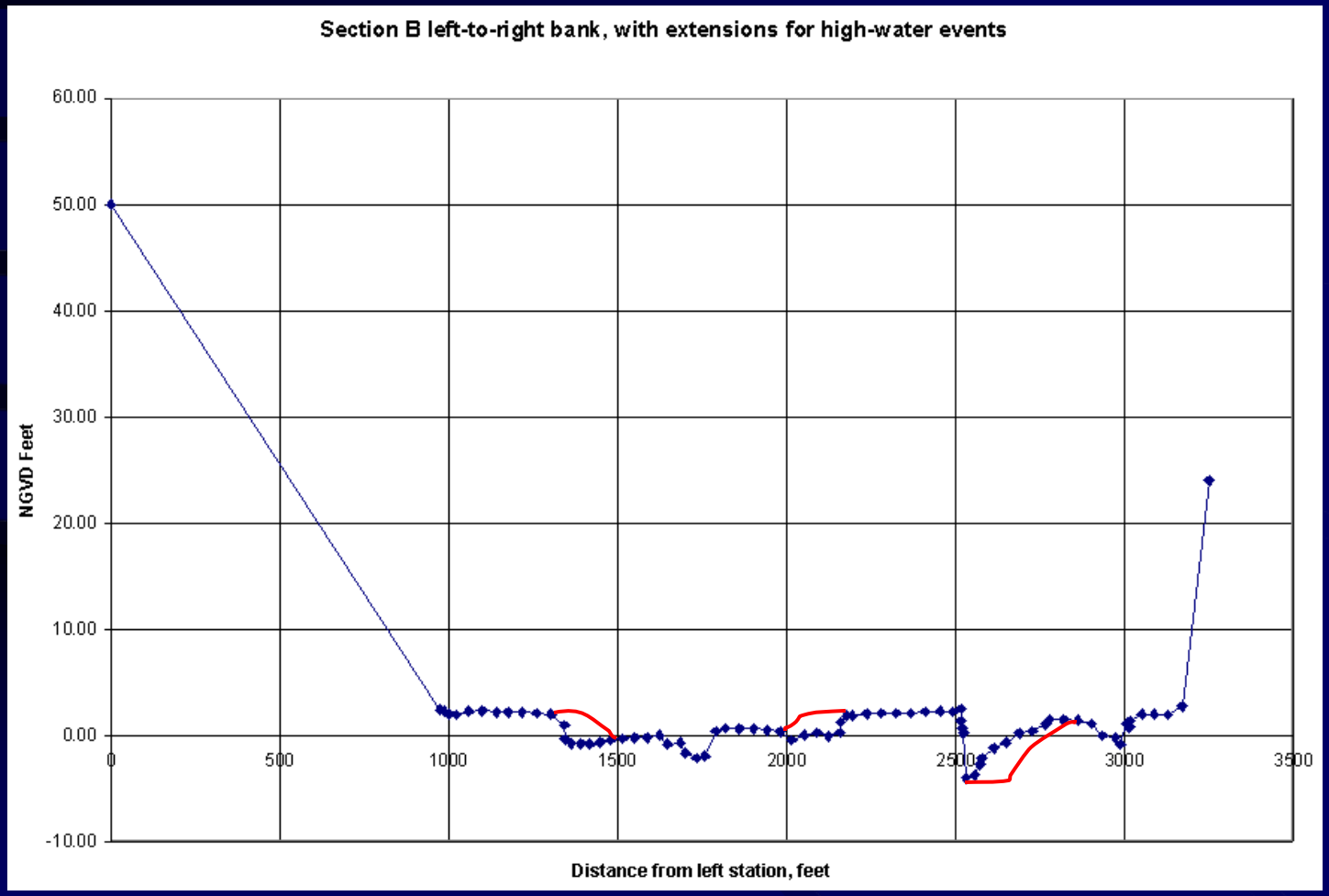
Tide Monitoring Results

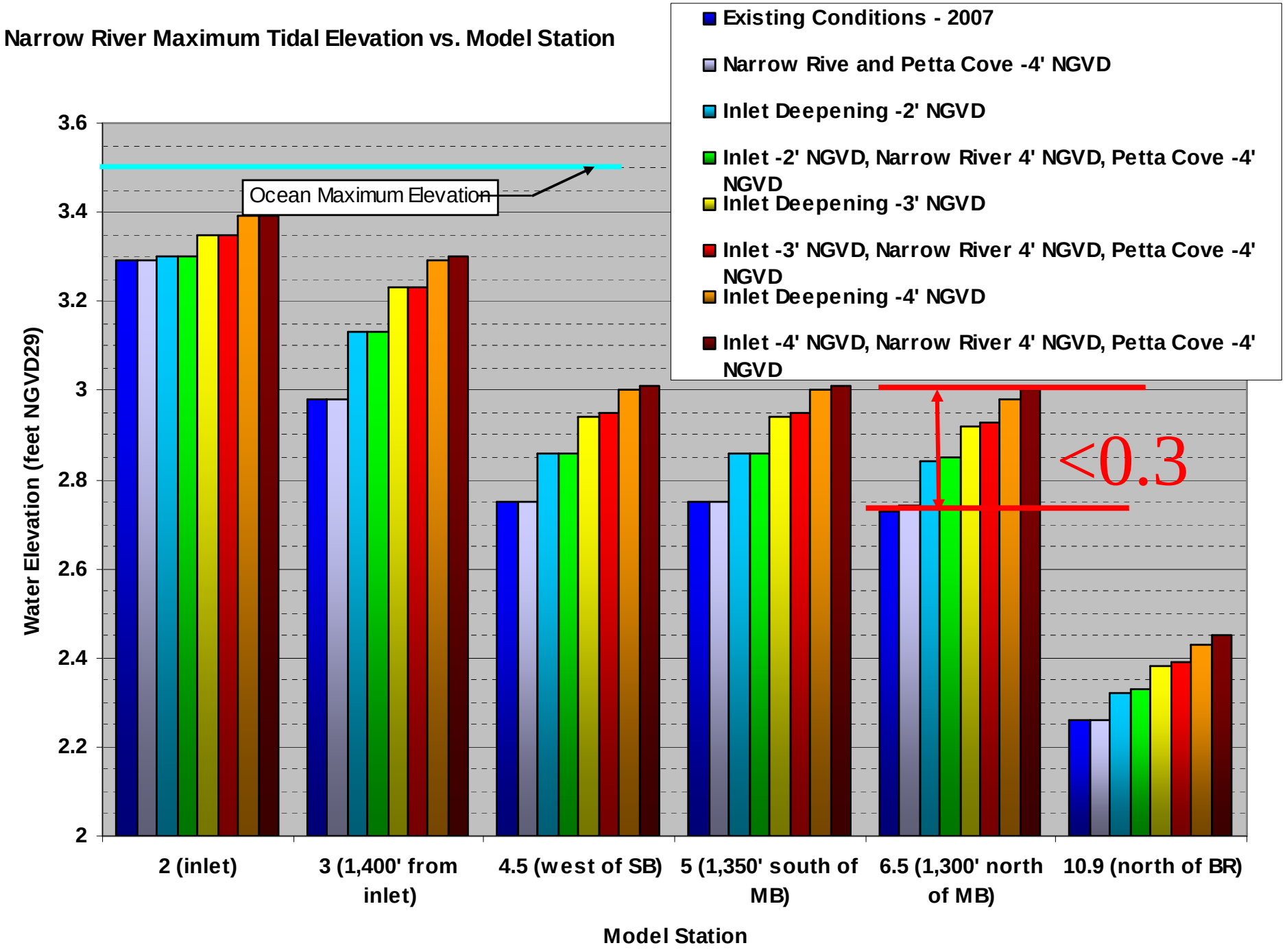


Elevation Transect Locations

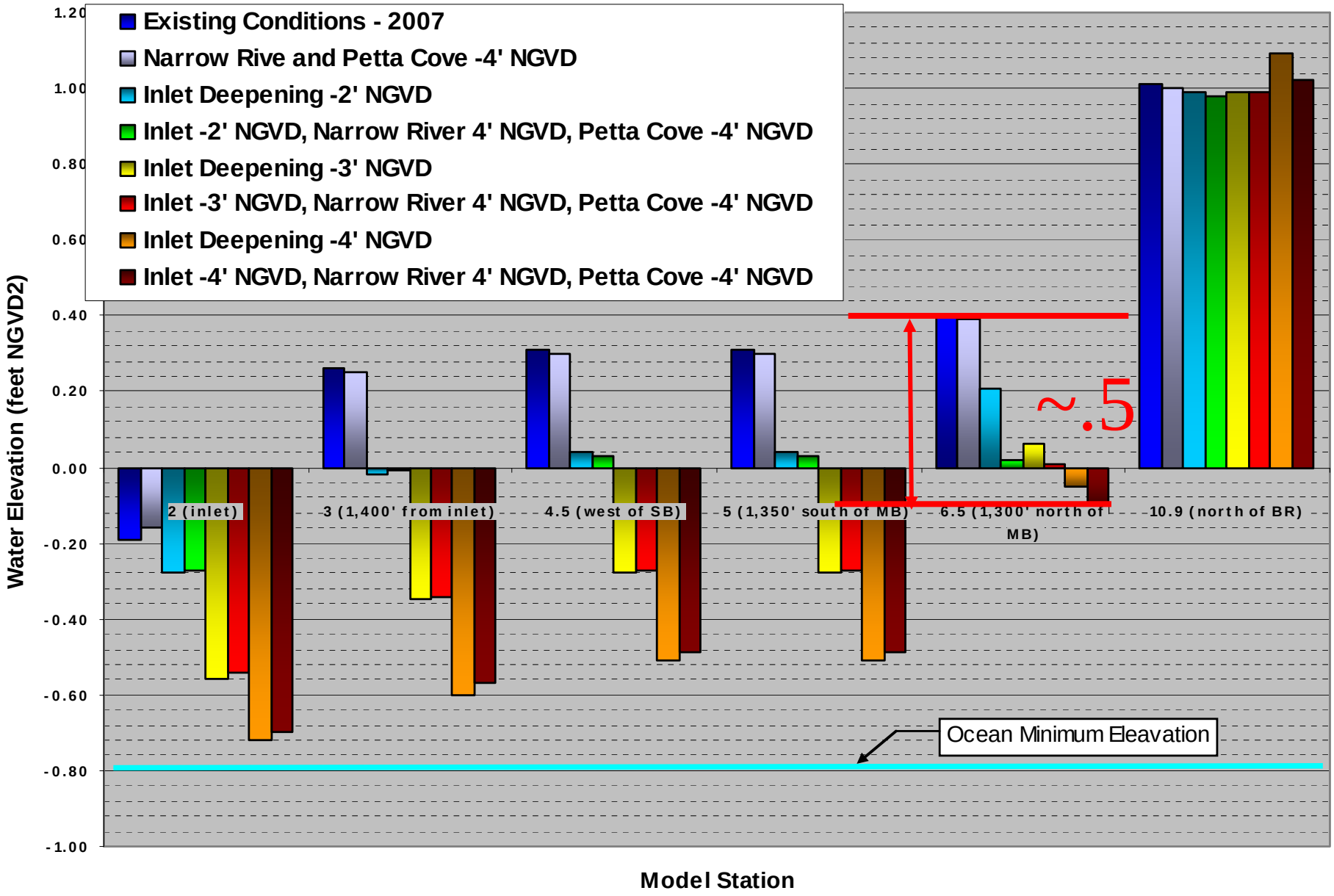


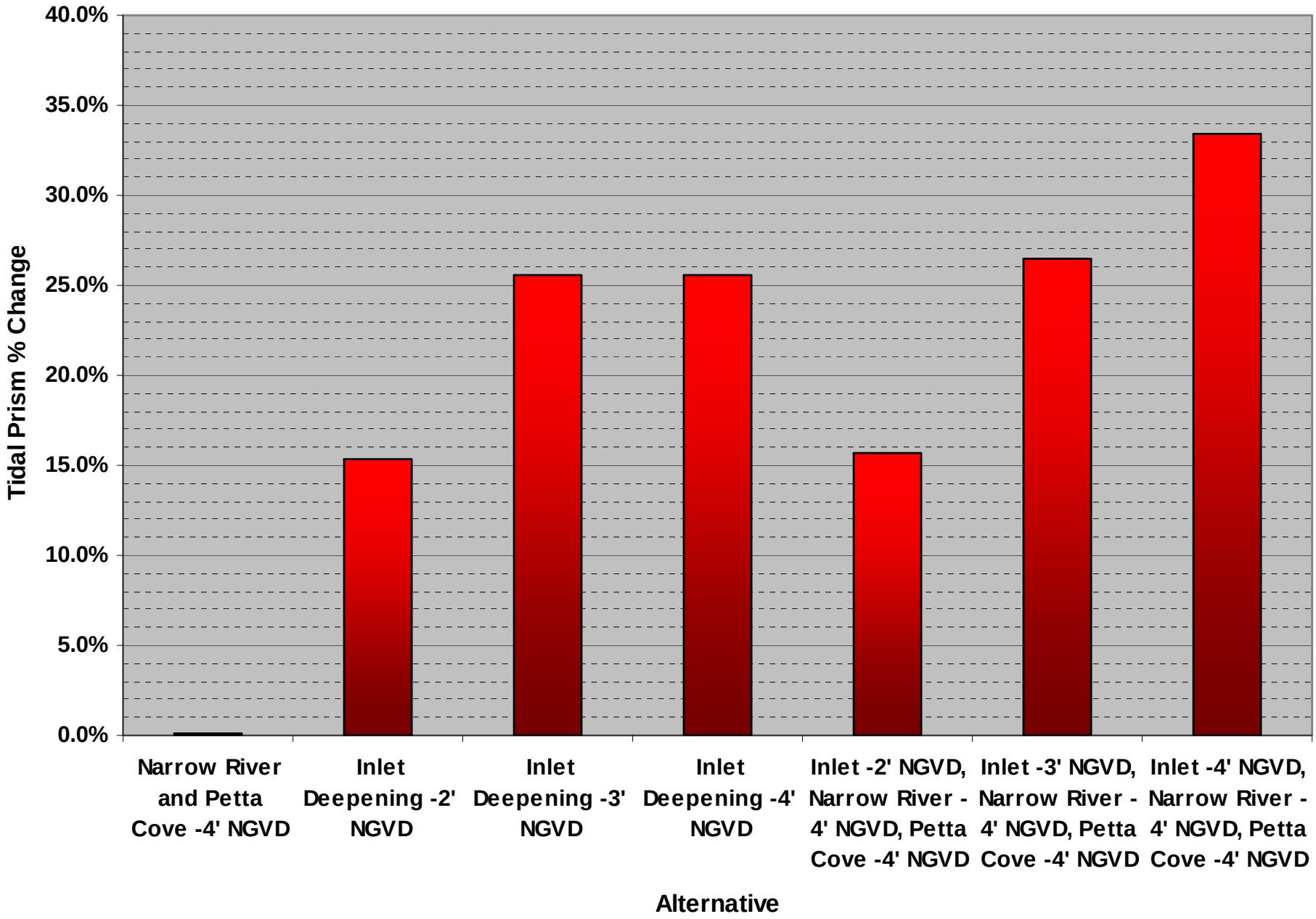
Survey Profile

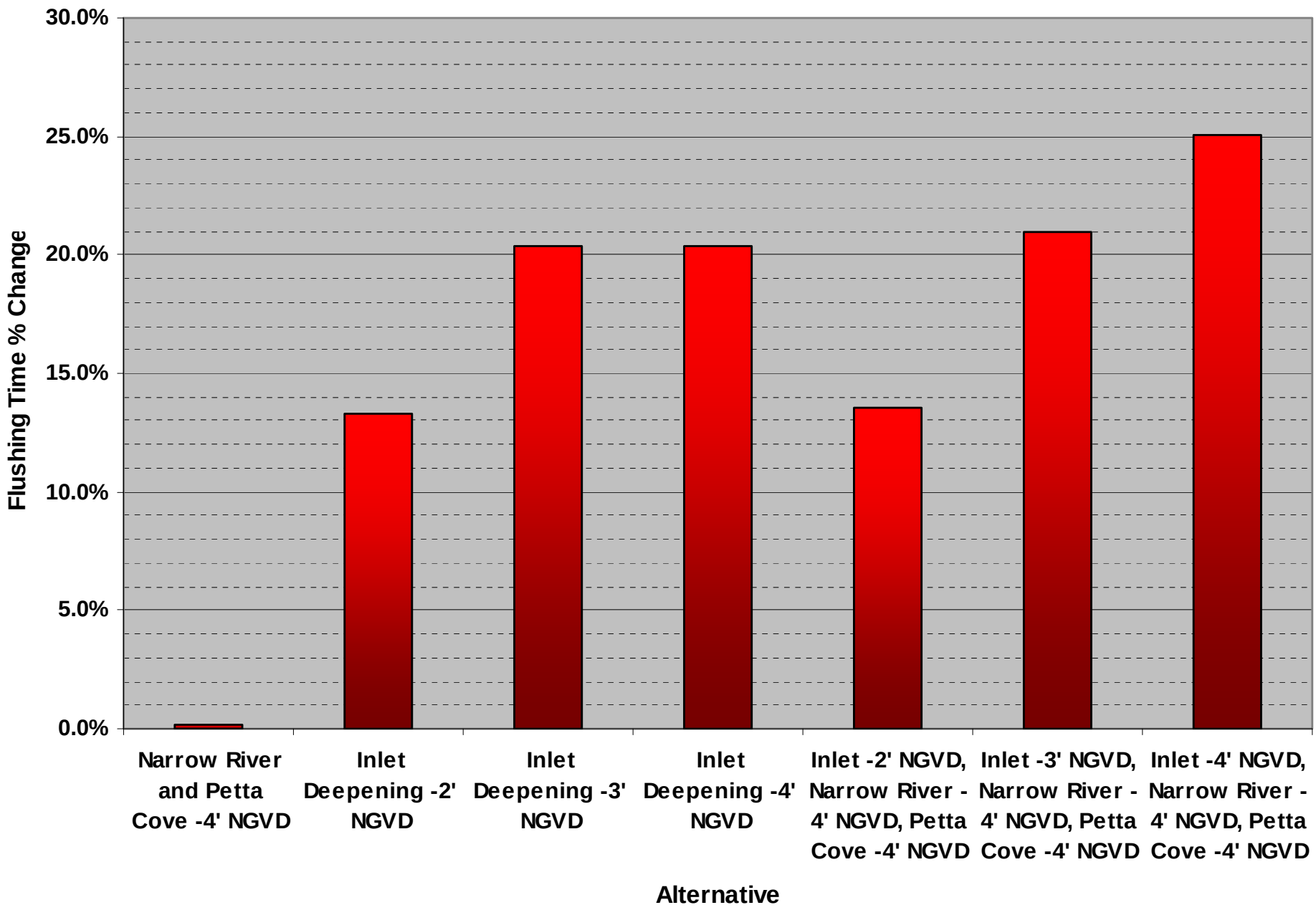



Narrow River Maximum Tidal Elevation vs. Model Station
Existing Conditions - 2007
Narrow Rive and Petta Cove -4' NGVD
Inlet Deepening -2' NGVD
Inlet -2' NGVD, Narrow River 4' NGVD, Petta Cove -4' NGVD
Inlet Deepening -3' NGVD
Inlet -3' NGVD, Narrow River 4' NGVD, Petta Cove -4' NGVD
Inlet Deepening -4' NGVD
Inlet -4' NGVD, Narrow River 4' NGVD, Petta Cove -4' NGVD
Ocean Maximum Elevation
<0.3
Water Elevation (feet NGVD29)
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
2 (inlet)
3 (1,400' from inlet)
4.5 (west of SB)
5 (1,350' south of MB)
6.5 (1,300' north of MB)
10.9 (north of BR)
Model Station

Narrow River Minimum Tidal Elevation vs. Model Station




Narrow River Modeled Tidal Prism
Percent Change vs. Alternative
Tidal Prism % Change
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Narrow River and Petta Cove -4' NGVD
Inlet Deepening -2' NGVD
Inlet Deepening -3' NGVD
Inlet Deepening -4' NGVD
Inlet -2' NGVD, Narrow River -4' NGVD, Petta Cove -4' NGVD
Inlet -3' NGVD, Narrow River -4' NGVD, Petta Cove -4' NGVD
Inlet -4' NGVD, Narrow River -4' NGVD, Petta Cove -4' NGVD
Alternative


Narrow River Modeled Flushing Time
Percent Reduction vs. Alternative
Flushing Time % Change
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Narrow River and Petta Cove -4' NGVD
Inlet Deepening -2' NGVD
Inlet Deepening -3' NGVD
Inlet Deepening -4' NGVD
Inlet -2' NGVD, Narrow River -4' NGVD, Petta Cove -4' NGVD
Inlet -3' NGVD, Narrow River -4' NGVD, Petta Cove -4' NGVD
Inlet -4' NGVD, Narrow River -4' NGVD, Petta Cove -4' NGVD
Alternative

Findings

- Significant increases in tidal prism and reductions in flushing times are possible with substantial changes to the inlet depth (e.g. to -4 ft NGVD)
- Minor increases in tidal elevations in lower system
- Significantly lower low tide elevations are possible with substantial inlet deepening
- Major dredging in the inlet could affect its stability – detailed modeling would be needed

NLM/ELM Modeling

Estuarine Loading Model

Open water area		*ha*
Salt marsh area		*ha*
Eelgrass bed area		*ha*
Average depth		*m*
Freshwater discharge volume from ground and surface water		*m cubed per yr*
Total watershed area (land)		*ha*
Length of receiving shoreline subtended		*m*
Number of houses		
Land derived TDN		*kg per yr*
Freshwater stream reaches TDN		*kg per yr*
Tidal range		*m*
Tidal period		*hrs per day*
Flushing time (hydrodynamic model input)		*days*
Flushing time of the freshwater reach		*days*

PRELIMINARY ELM OUTPUT

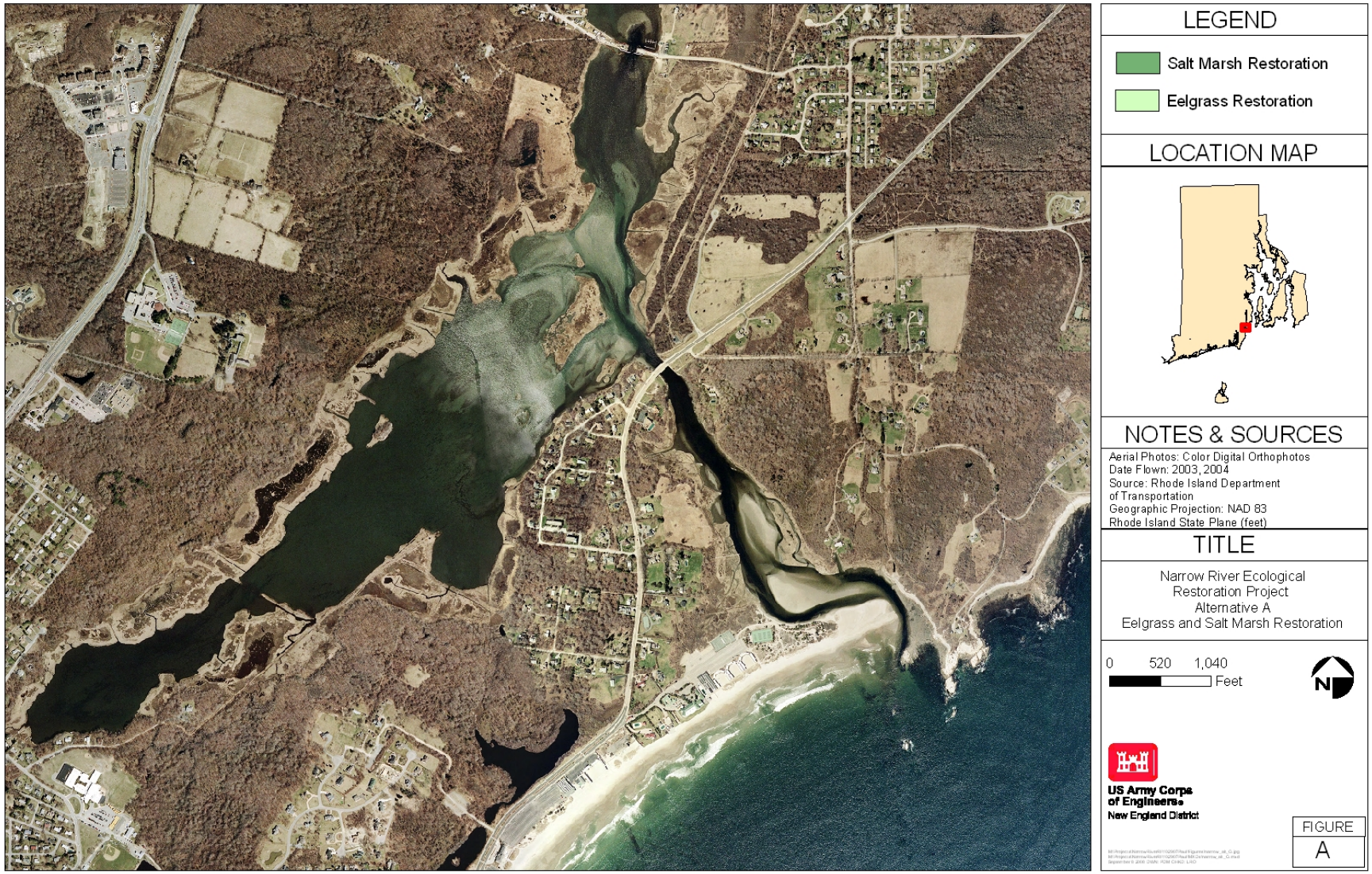
	Description	Total N Reduction (kg per year)	Percent N Reduction
1	No Action	-	-
2	Dredge all	57	0.2 %
3	17 acres SAV restoration	81	0.4 %
4	23 acres SAV restoration	111	0.5 %
5	65 acres SAV restoration	315	1.6 %
6	17 acres salt marsh restoration	537	2.7 %
7	17 acres salt marsh + 23 acres SAV	648	3.3 %
8	17 acres salt marsh + 23 acres SAV + dredge all	705	3.6 %

Preliminary Findings

- Dredging the inlet would not result in a substantial improvement in the quality of estuarine habitats
- The inlet shoals provide important water bird habitat, especially for migrating terns
- Dredging the shoals and placing the material on Narragansett Beach is not recommended

Restoration Alternatives

Alternative A – No Action



Alternative B

LEGEND

Salt Marsh Restoration

Eelgrass Restoration

LOCATION MAP

NOTES & SOURCES

Aerial Photos: Color Digital Orthophotos
Date Flown: 2003, 2004
Source: Rhode Island Department of Transportation
Geographic Projection: NAD 83
Rhode Island State Plane (feet)

TITLE

Narrow River Ecological Restoration Project
Alternative B
Eelgrass and Salt Marsh Restoration

0 500 1,000 Feet

N

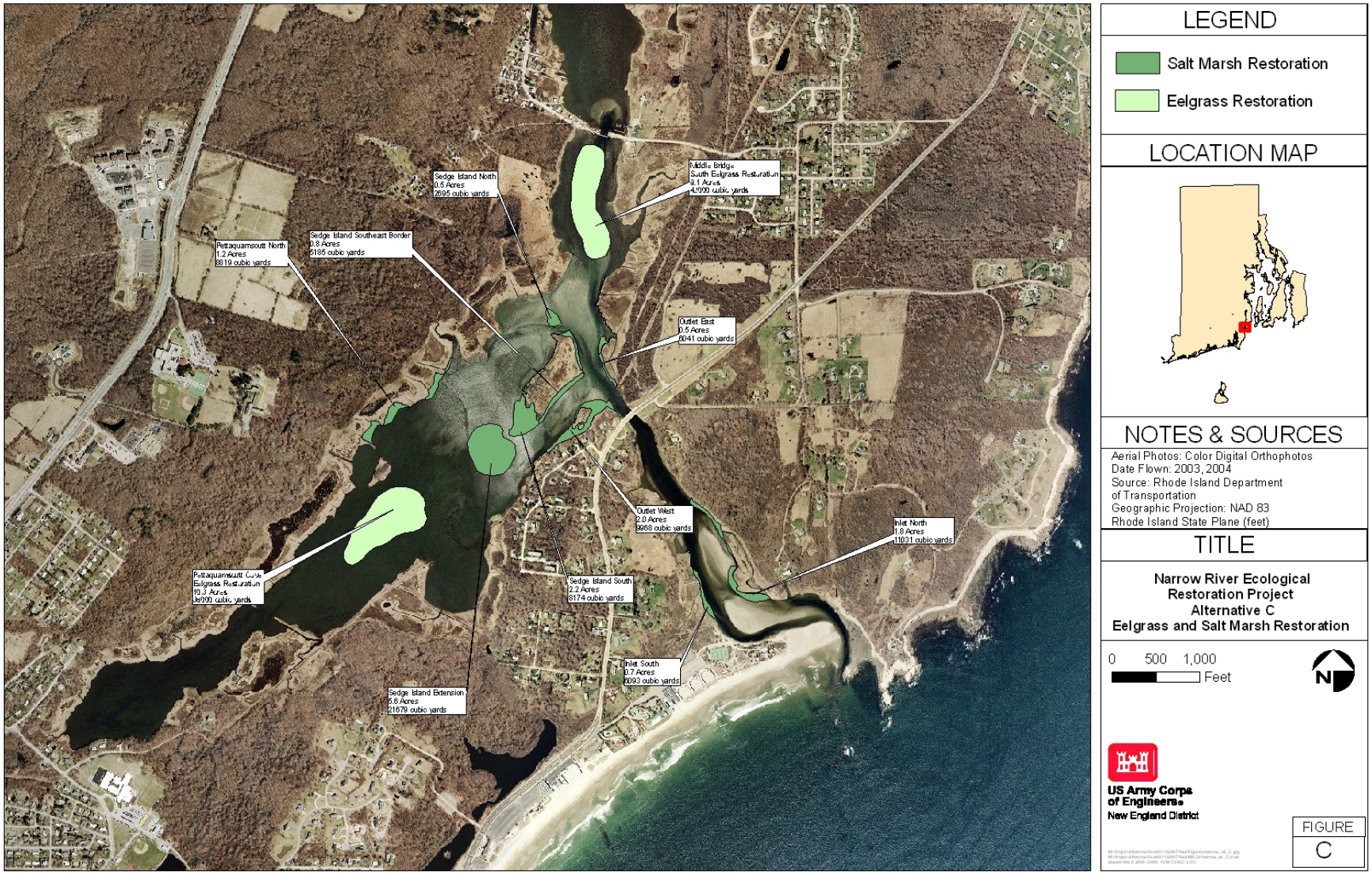
US Army Corps of Engineers
New England District

FIGURE
B

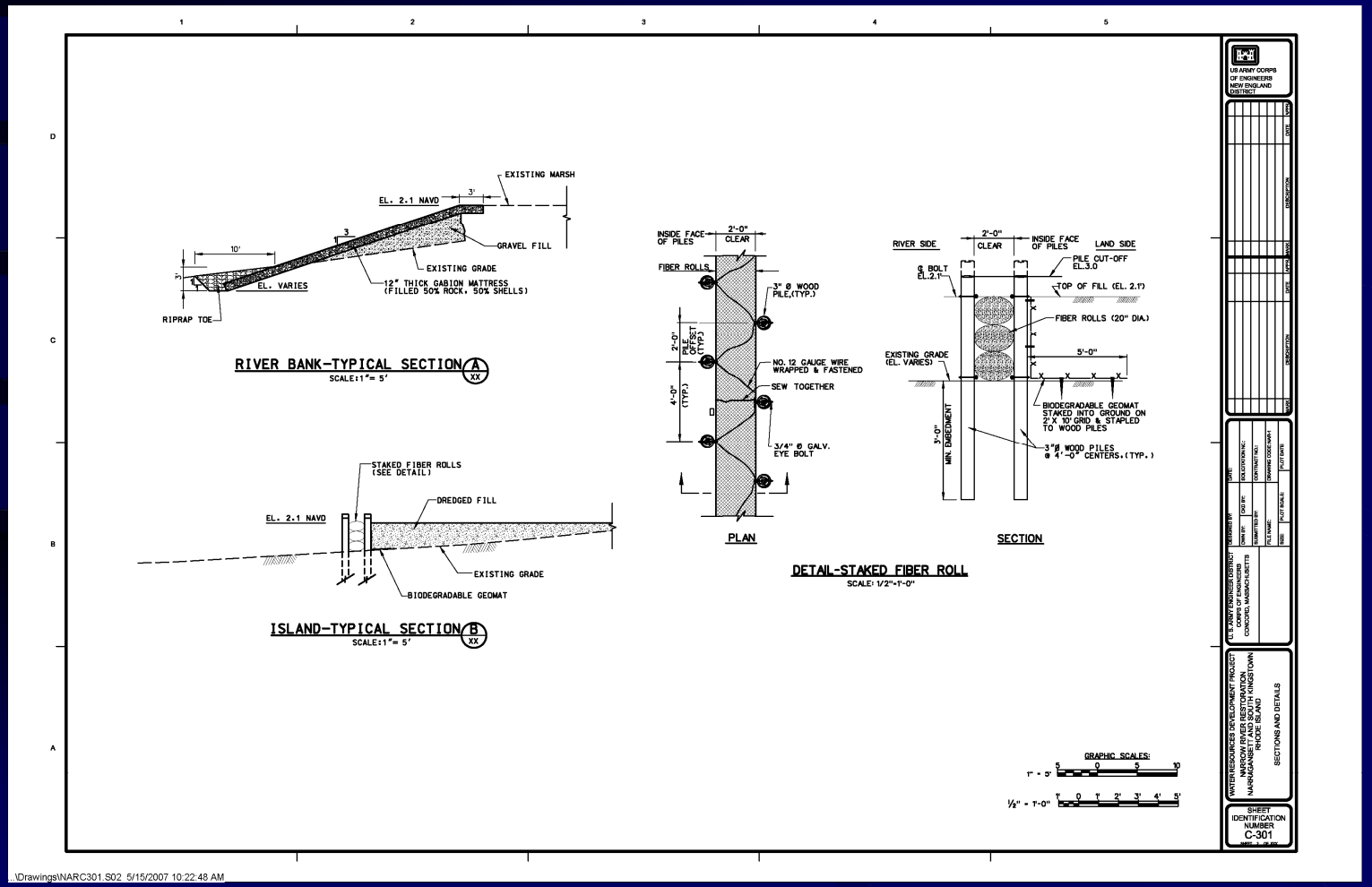
Ninigret Pond Eelgrass

Coir Log

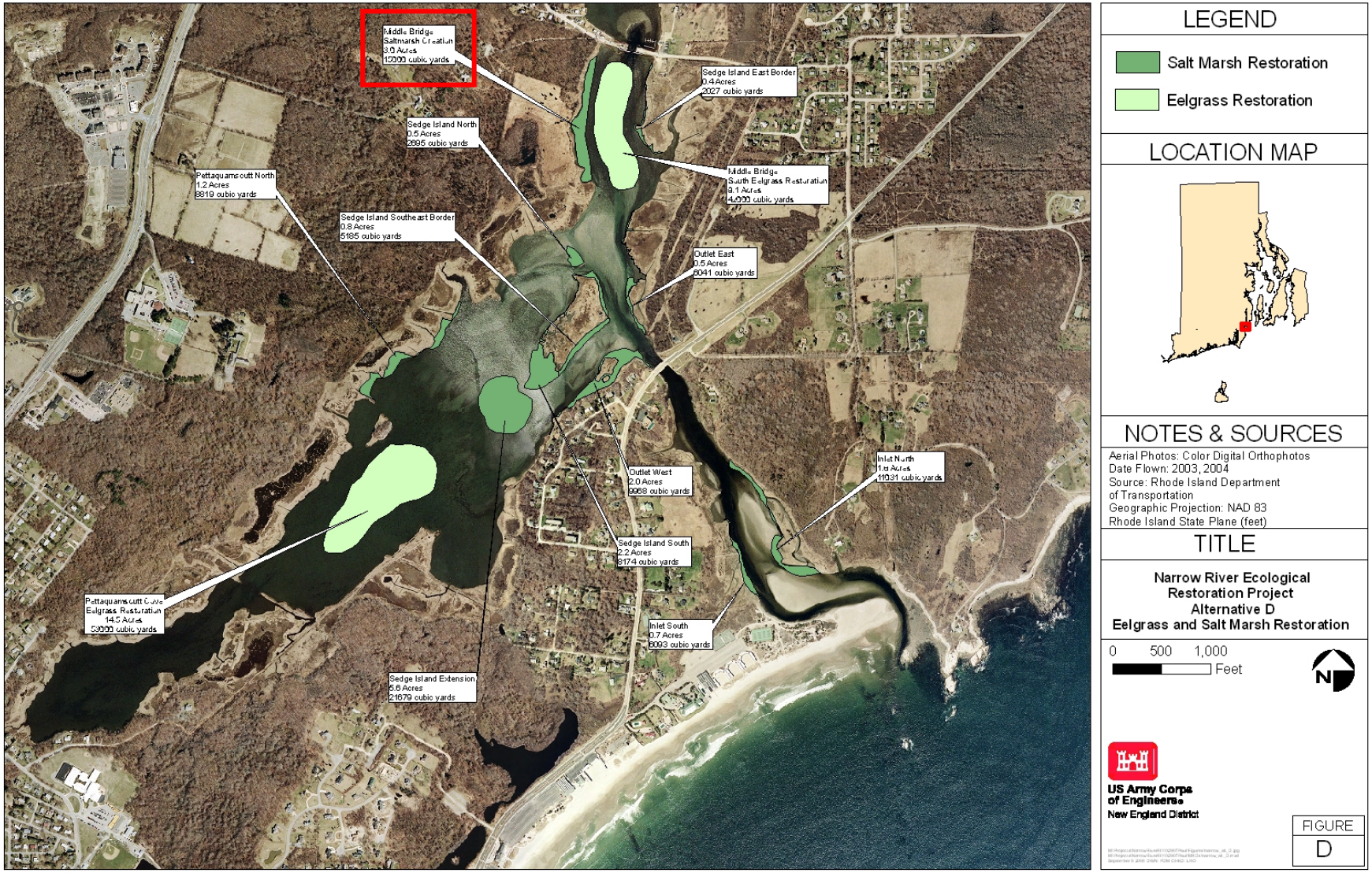
Alternative C



Slope Protection



Alternative D



Alternative E

LEGEND

- Salt Marsh Restoration
- Eelgrass Restoration

LOCATION MAP

NOTES & SOURCES

Aerial Photos: Color Digital Orthophotos
Date Flown: 2003, 2004
Source: Rhode Island Department of Transportation
Geographic Projection: NAD 83
Rhode Island State Plane (feet)

TITLE

Narrow River Ecological Restoration Project
Alternative E
Eelgrass and Salt Marsh Restoration

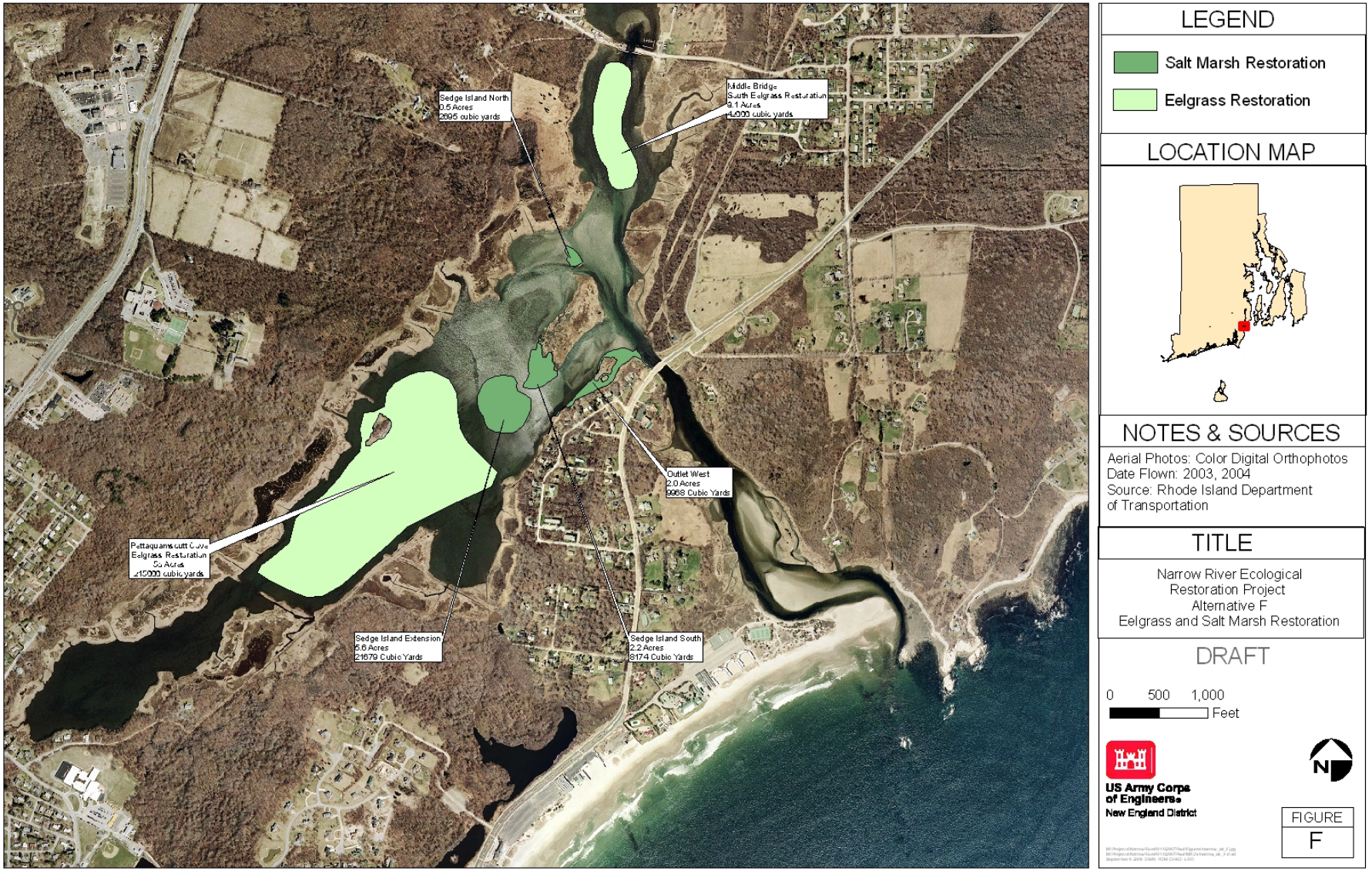
0 500 1,000
Feet

N

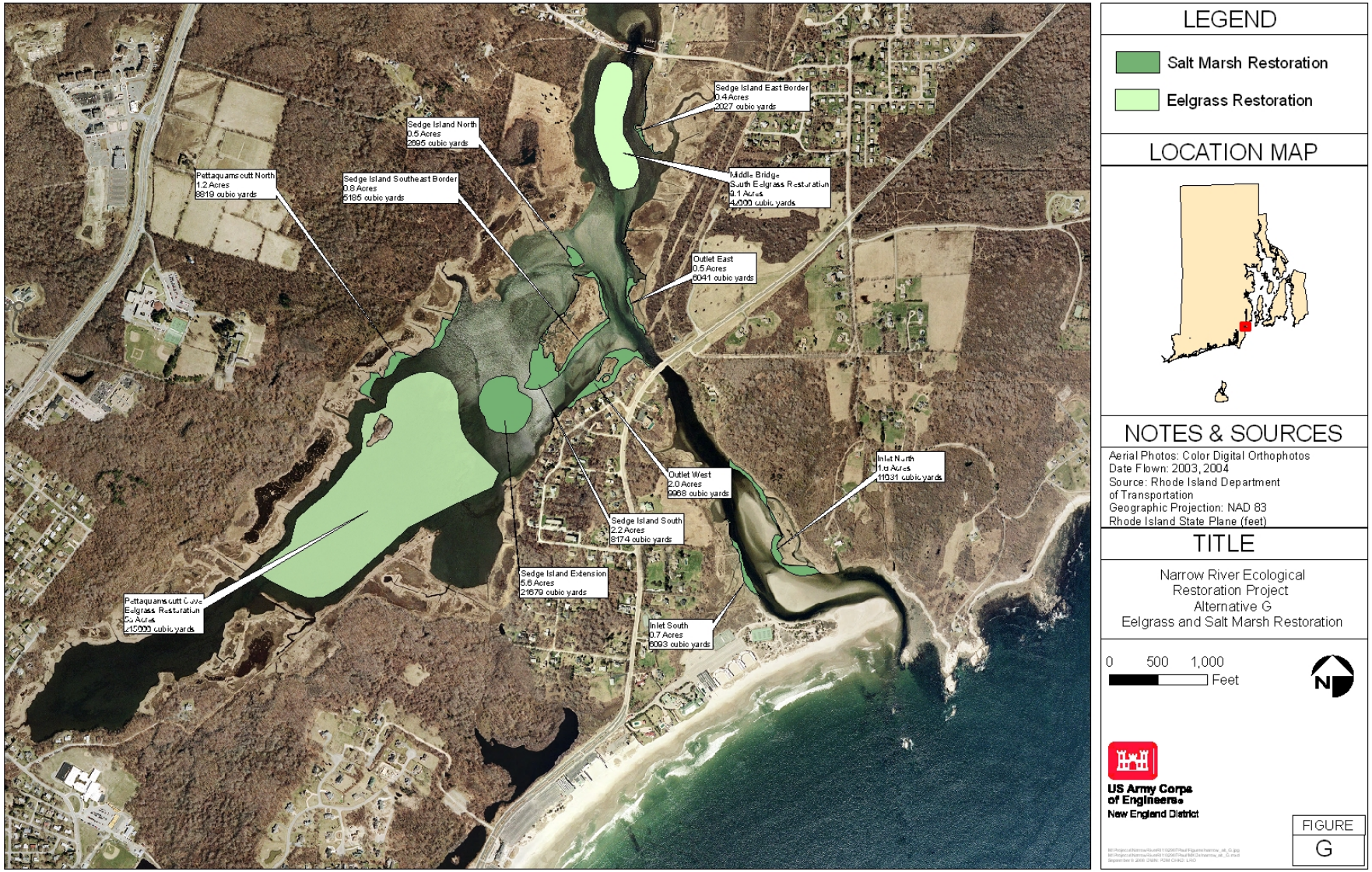
US Army Corps of Engineers
New England District

FIGURE
E

Alternative F



Alternative G



Alternative H

LEGEND

- Salt Marsh Restoration
- Eelgrass Restoration

LOCATION MAP

NOTES & SOURCES

Aerial Photos: Color Digital Orthophotos
Date Flown: 2003, 2004
Source: Rhode Island Department of Transportation
Geographic Projection: NAD 83
Rhode Island State Plane (feet)

TITLE

Narrow River Ecological Restoration Project
Alternative H
Eelgrass and Salt Marsh Restoration

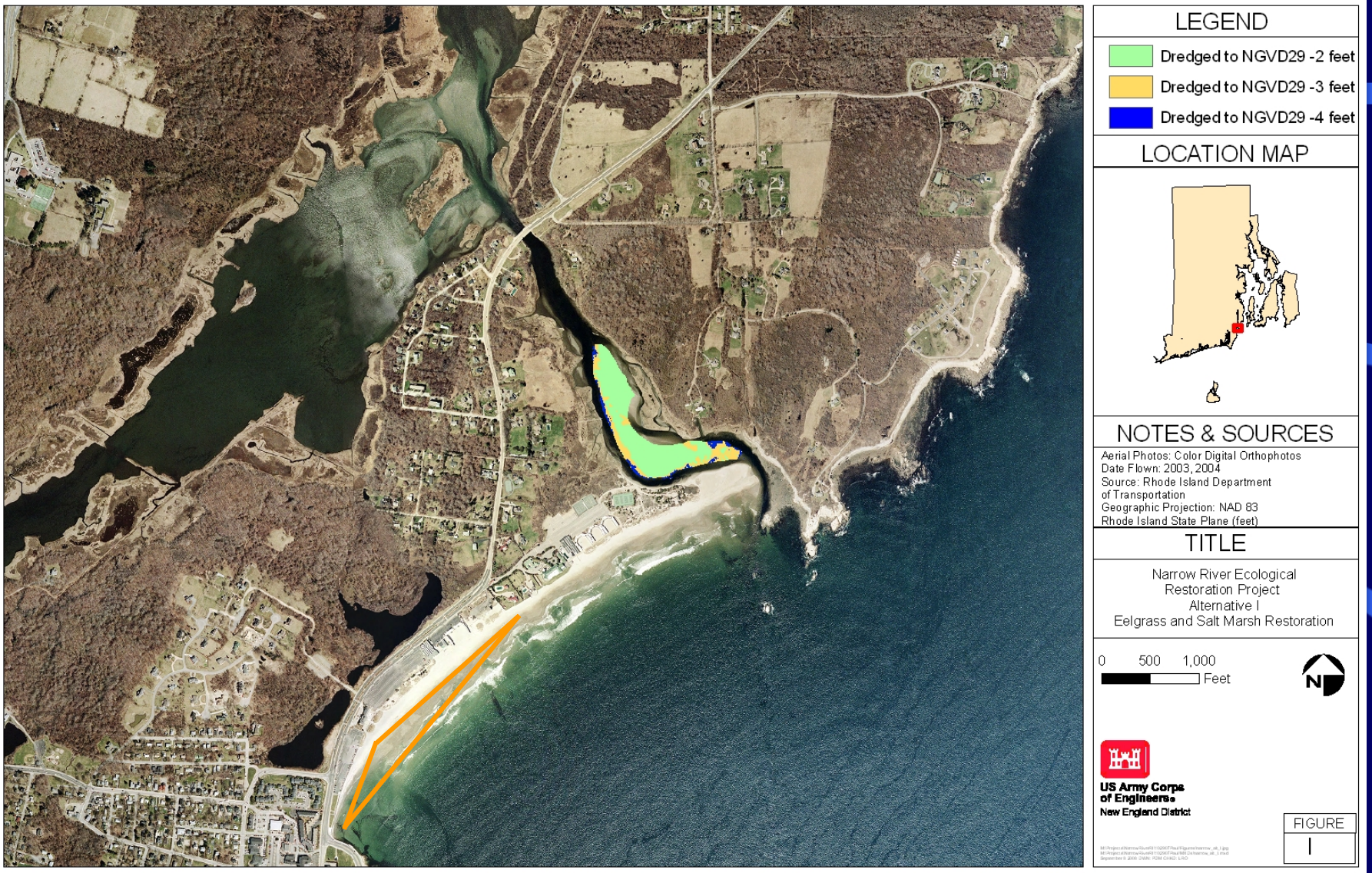
0 500 1,000
Feet

N

US Army Corps of Engineers
New England District

FIGURE
H

Alternative I



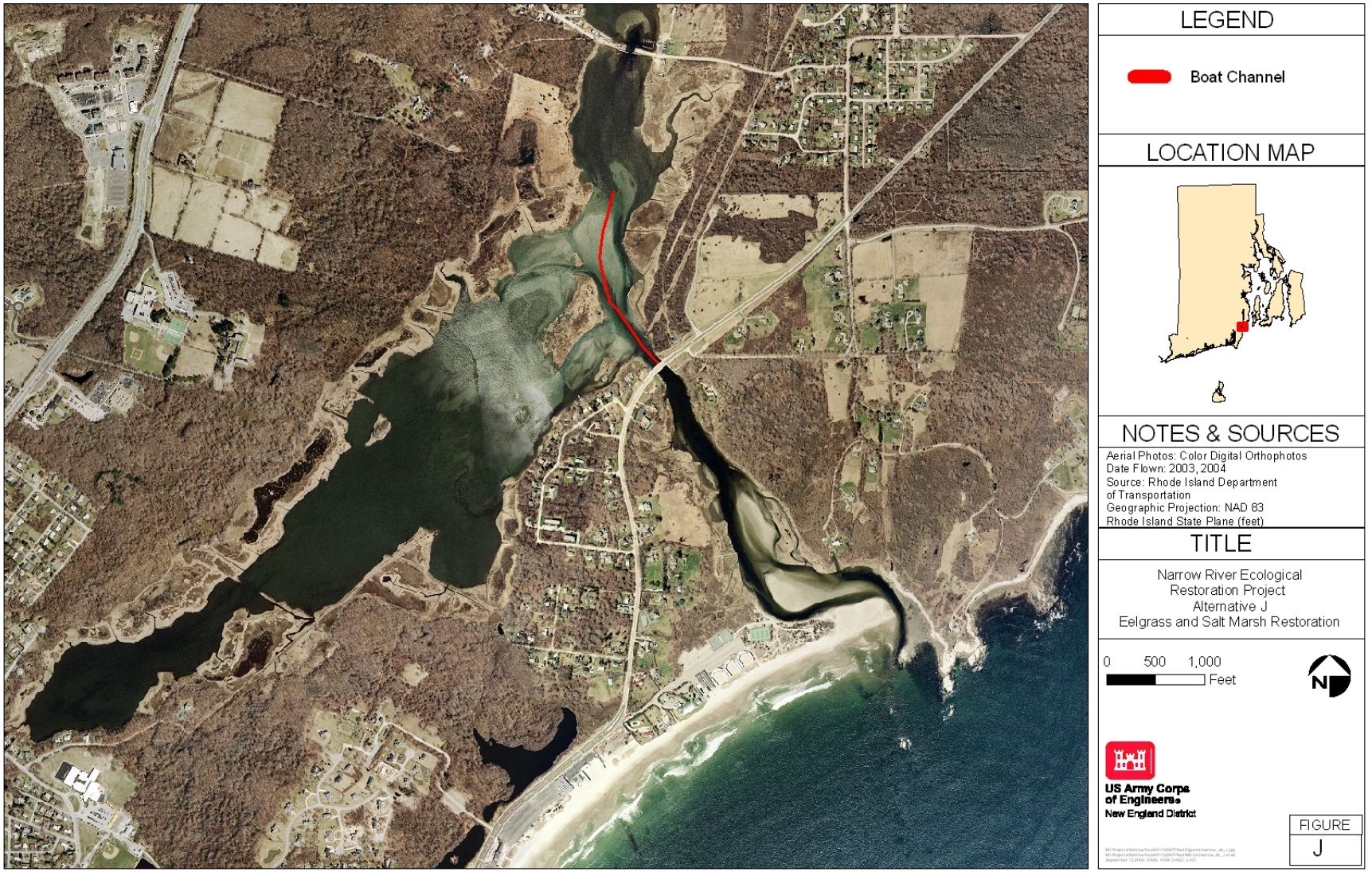
Preliminary Costs and Benefits

Alternative	EG	SM	Total	Cost (millions)
A	0	0	0	$0
B	9	10	19	$ 1.7
C	19	16	35	$ 3.7
D	34	19	52	$ 4.7
E	65	19	84	$ 10.0
F	65	12	77	$ 9.5
G	65	16	81	$ 10.1
H	65	15	80	$9.4

Preliminary Cost Effective Plans

Alternative	Acres	Cost (1,000s)	Avrg Cost/ Acre	IC per Acre
A	0	$0		
B	19	$ 1.7	$92	$92
C	35	$ 3.7	$107	$107
D	52	$ 4.7	$97	$99
H	80	$9.4	$123	$136
E	84	$ 10.0	$124	$165

Restoration Measure J



Restoration Measure K

LEGEND

Oysters

LOCATION MAP

NOTES & SOURCES

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Date Flown: 2003, 2004
Source: Rhode Island Department of Transportation
Geographic Projection: NAD 83
Rhode Island State Plane (feet)

TITLE

Narrow River Ecological Restoration Project
Alternative K
Eelgrass and Salt Marsh Restoration

0 500 1,000 Feet

N

US Army Corps of Engineers
New England District

FIGURE
K

Discussion

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